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Sir:

 Transmitted herewith for filing under 37 CFR 1.53(b) is a(n): ☒ Utility ☐ Design

☒ original patent application,

☐ continuation-in-part application

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INVENTOR(S): Akhil Sahai and Sekhar Sarukkai
TITLE: DECENTRALIZED MANAGEMENT OF COMPOSITE DIGITAL SERVICES

Enclosed are:

☒ The Declaration and Power of Attorney. ☒ signed ☐ unsigned or partially signed

☒ 3 sheets of drawings (one set) ☐ Associate Power of Attorney

☐ Form PTO-1449 ☐ Information Disclosure Statement and Form PTO-1449

☐ Priority document(s) ☐ (Other) _____ (fee \$ _____)

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INDEPENDENT CLAIMS	2 — 3	0	X \$78	\$ 0
ANY MULTIPLE DEPENDENT CLAIMS	0		\$260	\$ 0
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TOTAL FILING FEE				\$ 690
OTHER FEES				\$
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 By Paul H. Horstmann

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Respectfully submitted,

Akhil Sahai and Sekhar Sarukkai

By

Paul H. Horstmann

Attorney/Agent for Applicant(s)

Reg. No. 36,167

Date: 8-30-2000

Telephone No.: (415) 602-1721

UNITED STATES PATENT APPLICATION FOR

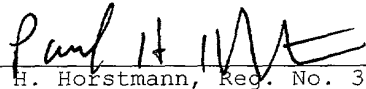
DECENTRALIZED MANAGEMENT OF
COMPOSITE DIGITAL SERVICES

Inventors:
Akhil Sahai
Sekhar Sarrukai

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Paul H. Horstmann, Reg. No. 36,167
Signature Date: 8-30-2000

BACKGROUND OF THE INVENTION

Field of Invention

5 The present invention pertains to the field of digital services. More particularly, this invention relates to mechanisms that enable decentralized management of composite digital services.

Art Background

10

A wide variety of digital services may be provided to users via large-scale networks. For example, the Internet commonly provides access to numerous digital services including information services and electronic commerce (e-commerce) services. Such services may be referred to as e-services.

20 Typically, a user interacts with an e-service using a client-server protocol. For example, users on the Internet commonly use a web client to interact with web servers that provide e-services.

25 Multiple e-services may be combined in a manner that enables users to access multiple e-services through a single server which is often referred to as a portal. For example, a group of e-commerce services may implement mechanisms that enable a user to access the inventories of each member of the group through a web portal. The e-services in such a group are commonly arranged in a tree structure in which each e-service communicates with one or more sub-services in the tree. Such an arrangement of e-

services may be referred to as a composite e-service.

5 It is often desirable to provide management
functions for composite e-services. An example of a
management function for a composite e-service is the
monitoring of the performance of the individual e-
services in the composite e-service. Other examples
of management functions include, security, and
10 accounting functions, etc, associated with the e-
services in the composite e-service.

Prior systems for managing e-services are
typically centralized in nature. For example, the
15 simple network management protocol (SNMP) is commonly
employed in local area networks and corporate
networks, etc. A system with SNMP usually includes a
central SNMP manager that communicates with a set of
SNMP agents which are distributed throughout the
20 network. Unfortunately, such a system of centralized
management is usually ill-suited to the decentralized
nature of composite e-services. Moreover, the
arrangement of e-services in a composite e-service
may change dynamically. Such centralized management
25 systems are typically ill-suited to adapt to such a
dynamically changing arrangements of e-services.

SUMMARY OF THE INVENTION

A system is disclosed that enables decentralized management of a composite e-service by obtaining
5 information which is useful for management of the composite e-service even when the arrangement of e-services that make up the composite e-service are dynamically changing. The system includes mechanisms for generating a set of management information for
10 each of a set of service interactions among the e-services that currently make up the composite e-service. The system includes mechanisms for transferring the sets of management information up a tree structure of the composite e-service to a e-
15 service in the tree structure that provides a portal to the composite e-service. The system also includes mechanisms for combining the management information at each of a set of levels of the tree structure. The management of the composite e-service is
20 decentralized because any e-service or any client may obtain and make use of the management information rather than a predefined central manager as in prior systems.

25 Other features and advantages of the present invention will be apparent from the detailed description that follows.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is described with respect to particular exemplary embodiments thereof and reference is accordingly made to the drawings in which:

Figure 1 shows an example of a composite e-service which is accessed by a client;

Figure 2 shows a set of service interactions among the e-services of a composite e-service and the handling of corresponding management objects;

Figure 3 shows one example implementation of the management elements of a e-service in a composite e-service.

DETAILED DESCRIPTION

Figure 1 shows an example of a composite e-service 100 which is accessed by a client 10. The composite e-service 100 includes a set of e-services 20-27. Each of the e-services 20-27 is an e-service which implements a boundary and interface specification that enables interactions with other communication elements. A boundary and interface specification may conform to industry standard including industry standards associated with Internet communication.

An e-service is a service which may be available via the Internet that completes tasks, solves problems, and/or conducts transactions. Virtually any asset including hardware and software and businesses processes, data, and expertise can be made available as an e-service to drive new revenue streams or create new efficiencies in the Internet economy. Examples of e-services are numerous and include on-line retail and wholesale e-services, business-to-business e-services, digital information services including news, sports, entertainment, educational, etc., on-line applications, and data service providers to name just a few examples.

The e-services 20-27 of the composite e-service 100 are arranged in a hierarchy. The e-service 20 provides the base or top level of the hierarchy and provides the client 10 with an access path or portal to the composite e-service 100. The e-services 21 and 22 are sub-services in relation to the e-service

20. Similarly, the e-services 23 and 24 are sub-services in relation to the e-service 22 and the e-services 25-27 are sub-services in relation to the e-service 23. Each sub-service defines a corresponding level of the hierarchy. The arrangement shown of the e-services 20-27 is only one example arrangement of a composite e-service and numerous others are possible including a tree composed of only two e-services.

10 In one embodiment, the client 10 is a world-wide-web (web) client and the e-service 20 is a web-based e-service. The client 10 and the e-service 20 communicate with one another using the Hyper Text Transfer Protocol (HTTP) of the Internet. The e-service 20 provides a web portal to the composite e-service 100.

Each sub-service in the composite e-service 100 may function as a web service for its corresponding parent e-service. For example, the e-services 21 and 22 may be implemented as web services in relation to the e-service 20. The e-service 20 may function as a web client when communicating with the e-services 21 and 22. Alternatively, the e-services 20-27 may interact with one another using another protocol - for example, the TCP of the Internet. The e-services 20-27 may implement a mixture of communication protocols for service interactions.

30 The e-services 20-27 collectively implement a service-to-service communication protocol which enables service interactions among the e-services 20-27. The service-to-service communication protocol

enables the e-services 20-27 to formulate the tree arrangement of the composite e-service 100. For example, the service-to-service communication protocol enables the e-services 20 and 22 to
5 formulate a composite e-service with the e-service 22 as a sub-service of the e-service 20. Similarly, the service-to-service communication protocol enables the e-services 22 and 24 to formulate a composite e-service with the e-service 24 as a sub-service of the
10 e-service 22.

The service-to-service communication protocol implemented by the e-services 20-27 may provide for dynamic composition of e-services. For example, the
15 service-to-service communication protocol may enable automatic negotiation and formation of composite services including bid submissions, contract generation, and digital signatures.

The service-to-service communication protocol implemented by the e-services 20-27 may be based on the exchange of XML documents among the e-services 20-27 using the HTTP protocol. One example of a service-to-service communication protocol is the ECO
20 framework which is based on the exchange of XML documents. Another example is Biztalk which is also XML-based. Yet another example of a service-to-service communication protocol is the E-Services Service Specification of Hewlett-Packard Company.
25

30 The client 10 interacts with the composite e-service 100 using one or more service interactions. The boundaries of a service interaction are defined

by a request from the client 10 and a corresponding response from the composite e-service 100. Any number of resulting service interactions may take place among the e-services 20-27 in between the request from the client 10 and the corresponding response back to the client 10. Each of the service interactions that take place among the e-services 20-27 includes a request and a corresponding response that completes/satisfies the request.

10

Figure 2 shows the composite e-service 100 at a point in time in which it is composed only of the e-services 20-24. This point in time may be before the e-service 23 has completed the negotiation of composite e-services with the e-services 25-27.

15

The following focuses on an example in which the composite e-service 100 is an on-line retail e-service in which any one or more of the e-services 20-24 provide their own inventory of retail items. The techniques disclosed herein are nevertheless applicable to numerous other types of e-services.

20

The client 10 generates a request (request(n)) to the e-service 20. For example, the request(n) may be a request generated by the client 10 to retrieve an inventory of items available through the composite e-service 100. The variable n is used as an indicator to identify the request throughout the composite e-service 100. The value of n may be generated by the client 10 or the composite e-service 100.

25

30

The request(n) may be an HTTP GET command that specifies a uniform resource locator (URL) which corresponds to the e-service 20. Alternatively, the request(n) may be composed of multiple HTTP commands or another type or types of commands such as FTP commands, etc.

The request(n) is received by the e-service 20 which functions as a portal to the composite e-service 100. The e-service 20 handles the request(n) by generating a request (request(n,1)) to the e-service 21 and a request (request(n,2)) to the e-service 22 in accordance with the terms of the composite e-service 100. The e-service 20 may also perform its own internal operations in order to satisfy the request(n).

In the above example for the request(n), the request(n,1) may be a request generated by the e-service 20 to retrieve an inventory of items available through the e-service 21 and the request(n,2) may be a request generated by the e-service 20 to retrieve an inventory of items available through the e-service 22. This is in accordance with the service agreement previously negotiated among the e-services 20-22. The request(n,1) and the request(n,2) may be HTTP GET commands that specify URLs which correspond to the e-services 21 and 22, respectively, or may be FTP commands, etc.

The e-service 21, which currently has no sub-services in this example, handles the request(n,1)

internally by generating a list of inventory items and sending the list back to the e-service 20 in a response (response(n,1)) to the request(n,1). The e-service 21 also generates a management object
5 (management_object(n,1)) and transfers it back to the e-service 20 after completing the request(n,1). The management_object(n,1) contains a set of management-specific information associated with the servicing of the request(n,1) by the e-service 21.

10

The e-service 22 handles the request(n,2) by generating a request (request(n,2,1)) to the e-service 23 and a request (request(n,2,2)) to the e-service 24 in accordance with the terms of the
15 composite e-service 100. The e-service 22 may also perform its own internal operations in order to satisfy the request(n,2).

20

The e-service 23, which currently has no sub-services in this example, handles the request(n,2,1) internally by generating a list of inventory items and sending the list back to the e-service 22 in a response (response(n,2,1)) to the request(n,2,1). The e-service 23 generates a management object
25 (management_object(n,2,1)) and transfers it back to the e-service 22 after satisfying the request(n,2,1). The management_object(n,2,1) contains a set of management-specific information associated with the servicing of the request(n,2,1) by the e-service 23.

30

Similarly, the e-service 24 handles the request(n,2,2) internally by generating a list of inventory items and sending the list back to the e-

service 22 in a response (response(n,2,2)). The e-service 24 generates a management object (management_object(n,2,2)) and transfers it back to the e-service 22 after satisfying the request(n,2,2).
5 The management_object(n,2,2) contains a set of management-specific information associated with the servicing of the request(n,2,2) by the e-service 24.

10 The e-service 22 receives the response(n,2,1) and the response(n,2,2) from the e-services 23 and 24, respectively, and in turn generates a response (response(n,2)) back to the e-service 20 to satisfy the request(n,2). The e-service 22 also receives the management_object(n,2,1) and the
15 management_object(n,2,2) from the e-services 23 and 24, respectively, and combines them into a management_object (management_object(n,2)). The e-service 22 may also include in the management_object(n,2) a set of management-specific
20 information associated with its servicing of the request(n,2). The e-service 22 correlates the management_object(n,2,1) and the management_object(n,2,2) and its own internal management information using the value for the
25 variable n. The e-service 22 transfers the management_object(n,2) back up to the e-service 20 after satisfying the request(n,2).

30 Likewise, the e-service 20 receives the response(n,1) and the response(n,2) from the e-services 21 and 22, respectively, and in turn generates a response (response(n)) back to the client 10 to satisfy the request(n). The e-service 20 also

receives the management_object(n,1) and the
management_object(n,2) from the e-services 21 and 22,
respectively, and combines them into a
management_object (management_object(n)). The e-
5 service 20 may also include in the
management_object(n) a set of management-specific
information associated with its servicing of the
request(n). The e-service 22 correlates the
management_object(n,1) and the management_object(n,2)
10 and its own internal management information using the
value for the variable n.

The e-service 20 may itself act upon the
information in the management_object(n) and perform
15 management functions for the composite service 100.
Alternatively, the e-service 20 transfer the
management_object(n) to another e-service which
performs management functions. The e-service 20 may
use the information from the management_object(n) to
20 provide further interactions with the client 10 such
as billing for services, etc.

Multiple service interactions may take place at
any point in the tree structure of the composite e-
25 service 100 in between the request(n) and the
response(n). For example, the e-service 20 may issue
a series of m requests (request[(n,1)(1)] through
request[(n,1)(m)]) to the e-service 21 and receive
back a series of m responses (response[(n,1)(1)]
30 through response[(n,1)(m)]). After each
response[(n,1)(m)] the e-service 21 transfers a
corresponding management_object[(n,1)(m)] back up to

the e-service 20 and the e-service 20 combines them using the variable n as appropriate.

Figure 3 shows one example implementation of the management elements of the e-services 22 and 24. In this example, the e-services 22 and 24 each include a manager, the managers 42 and 52, respectively, that enable decentralized management of composite e-services as taught herein. The remaining of the e-services 20-27 may be implemented with managers in a similar manner.

The e-service 22 includes an application 40 that obtains the request (n,2) from the e-service 20. The application 40 handles the request (n,2) by issuing the request(n,2,2) to the e-service 24 and optionally performing its own internal operations to satisfy the request(n,2).

The manager 42 gathers a set of predefined management parameters which are associated with the servicing of the request(n,2) by the e-service 22. For example, the manager 42 may measure the amount of time taken by the application 40 to performs its internal operations in response to the request (n,2). As another example, the manager 40 may log errors that may occur in the e-service 22 during the servicing of the request (n,2). These are just a couple of examples of the management parameters that may be gathered by the manager 42 and numerous others are possible.

In a similar manner, an application 50 in the e-service 24 services the request (n,2,2) from the e-service 20 while the manager 52 gathers a set of predefined management information which is associated with the servicing of the request(n,2,2) by the e-service 24. For example, the manager 52 may measure the amount of time taken by the application 50 to service the request (n,2,2), and/or may log errors that occur in the e-service 24 during the servicing of the request (n,2,2), etc.

Upon completion of its handling of the request(n,2,2), the application 50 transfers the response(n,2,2) back up to the e-service 22. The manager 52 assembles the gathered management information associated with the servicing of the request(n,2,2) by the e-service 24 into the management_object(n,2,2) and transfer the management_object(n,2,2) to the application 50. The application 50 then relays the management_object(n,2,2) back to the e-service 22.

The application 40 receives the management_object(n,2,2) from the e-service 24 and relays it to the manager 42. Upon completion of its handling of the request(n,2) and receipt of the response(n,2,2), the application 40 transfers the response(n,2) back up to the e-service 20. The manager 42 assembles the management information associated with the servicing of the request(n,2) by the e-service 22 into the management_object(n,2). The manager 42 also uses the value of the variable n to combine the information from the

management_object(n,2,2) into the
management_object(n,2). The combining of the
management information may take any form such as the
tallying indicators and/or the summation and/or
5 concatenation of parameters as appropriate to name a
few possibilities.

Although not shown in **Figure 3**, the manager 42
additionally combines the information from the
10 management_object(n,2,1) into the
management_object(n,2). The manager 42 then
transfers the management_object(n,2) to the
application 40 which relays the
management_object(n,2) back up to the e-service 20.

15 The applications 40 and 50 and the managers 42
and 52 are adapted to underlying execution
environments of the e-services 22 and 24. For
example, if the e-service 22 provides a Java
20 environment then the application 40 and the manager
42 may be Java servlets. If the e-service 22 is a
platform that employs a particular operation system,
then the application 40 and the manager 42 may be
application programs that run under the particular
25 operating system. Communication between the
applications 40 and 50 and the corresponding managers
42 and 52 may be accomplished using any known
mechanism that is enabled by the underlying execution
environment. The managers 42 and 52 may make use of
30 underlying system utilities for gathering and
recording management information.

The techniques disclosed herein may be implemented using any underlying execution environment or hardware/software platform for the e-services 20-27. The e-services 20-27 may be implemented on different machines or any one or more of the e-services 20-27 may be implemented on the same machine. In addition, the e-services 20-27 may be implemented using different underlying environments. For example, the e-service 22 may be implemented in a Java environment whereas the e-service 24 may be implemented in a windows environment so long as a appropriate common format for the management_objects is used.

The information gathered by the managers and assembled into management_objects may include any number and variety of parameters that are useful in management of composite e-services. Examples include the time it takes for an e-service to complete a request, indications of errors (hardware and/or software) that occurred while servicing a request, costs associated with the servicing of a request, security violations that occur during the servicing of a request, and resource usage associated with the servicing of a request, to name a few examples. Any type of format may be employed for a management object. The following is one example of a management_object which is an XML document.

```
<MANAGEMENT_OBJECT>
  <Events>
    <ITEM>
      <EVENT_TYPE>E-service Exception
    </EVENT_TYPE>
    <AT_TIME>
      34678909
```

```
5      </AT_TIME>
      <MESSAGE>
      e-service1.com Unavailable
      </MESSAGE>

10      <EVENT_TYPE>
      E-service.Success
      </EVENT_TYPE>
      <MESSAGE>

      </ITEM>

      <ITEM>
      E-service2.com
      successfully accessed
      </MESSAGE>
      <AT_TIME>
      34567804
      </AT_TIME>
      </ITEM>

      </Events>

25      <PERFORMANCE>
      <ITEM>
      <E-service_ACCESSED_URL>
      http: //www.e-
      service2.com
      </E-service_ACCESSED_URL>
      <ACCESS_DURATION_SECS>
      1005
      </ACCESS_DURATION_SECS>
      <ACCESS_TIME_OFTHEDAY>
      12457890
      </ACCESS_TIME_OFTHEDAY>
      </ITEM>
      </PERFORMANCE>

40      <SECURITY>
      <FIREWALL_TRAVERSAL>
      YES
      </FIREWALL_TRAVERSAL>
      <FIREWALL_AT>
      http://e-service2.com
      </FIREWALL_AT>
      </SECURITY>

50      </MANAGEMENT_OBJECT>
```

The foregoing detailed description of the present invention is provided for the purposes of illustration and is not intended to be exhaustive or to limit the invention to the precise embodiment

[illegible]

CLAIMS

What is claimed is:

- 5 1. A method for obtaining information useful for management of a composite e-service, comprising the steps of:

 generating a set of management information for each of a set of service interactions among a set of
10 e-services in the composite e-service, the e-services arranged in a tree structure including one of the e-services that provides a portal to the composite e-service;

 transferring the sets of management information
15 up the tree structure to the e-service that provides the portal and combining the management information at each of a set of levels of the tree structure.

- 20 2. The method of claim 1, wherein the each service interaction comprises a request from one of the e-services and a response from a sub-service in the tree that handles the request.

- 25 3. The method of claim 1, wherein the each set of management information is contained in a management object.

- 30 4. The method of claim 3, wherein the management object has the form of an XML document.

5. The method of claim 1, wherein the step of combining the management information comprises the step of combining the management information using an

indicator carried in each set of management information that identifies a service interaction between a client and the portal.

5 6. The method of claim 1, wherein the management information includes a time taken by the corresponding e-service to complete a corresponding request.

10 7. The method of claim 1, wherein the management information includes an indication of errors that occurred in the corresponding e-service while servicing a corresponding request.

15 8. The method of claim 1, wherein the management information includes a set of costs incurred in the corresponding e-service while servicing a corresponding request.

20 9. The method of claim 1, wherein the management information includes an indication of security violations that occurred in the corresponding e-service while servicing a corresponding request.

25 10. The method of claim 1, wherein the management information includes an indication of resource usage in the corresponding e-service while servicing a corresponding request.

30 11. A composite e-service comprising a set of e-services arranged in a tree structure including one of the e-services that provides a portal to the

composite e-service, each e-service having a manager such that the managers collectively generate a set of management information for each of a set of service interactions among the e-services and transfer the sets of management information up the tree structure to the e-service that provides the portal while combining the management information at each of a set of levels of the tree structure.

12. The composite e-service of claim 11, wherein each e-service includes an application that processes the corresponding service interaction while the corresponding manager gathers the corresponding management information.

13. The composite e-service of claim 11, wherein the managers assemble the management information into a set of management objects.

14. The composite e-service of claim 13, wherein each management object has the form of an XML document.

15. The composite e-service of claim 11, wherein the managers combine the management information using an indicator carried in each set of management information that identifies a service interaction between a client and the portal.

16. The composite e-service of claim 11, wherein the management information includes a time taken by the corresponding e-service to complete a corresponding request.

17. The composite e-service of claim 11, wherein the management information includes an indication of errors that occurred in the corresponding e-service while servicing a corresponding request.

5

18. The composite e-service of claim 11, wherein the management information includes a set of costs incurred in the corresponding e-service while servicing a corresponding request.

10

19. The composite e-service of claim 11, wherein the management information includes an indication of security violations that occurred in the corresponding e-service while servicing a corresponding request.

15

20. The composite e-service of claim 11, wherein the management information includes an indication of resource usage in the corresponding e-service while servicing a corresponding request.

20

ABSTRACT

A system that enables decentralized management of a composite e-service by obtaining information which is useful for management of the composite e-service even when the arrangement of e-services that make up the composite e-service are dynamically changing. The system includes mechanisms for generating a set of management information for each of a set of service interactions among the e-services that currently make up the composite e-service. The system includes mechanisms for transferring the sets of management information up a tree structure of the composite e-service to an e-service in the tree structure that provides a portal to the composite e-service. The system also includes mechanisms for combining the management information at each level of the tree structure.

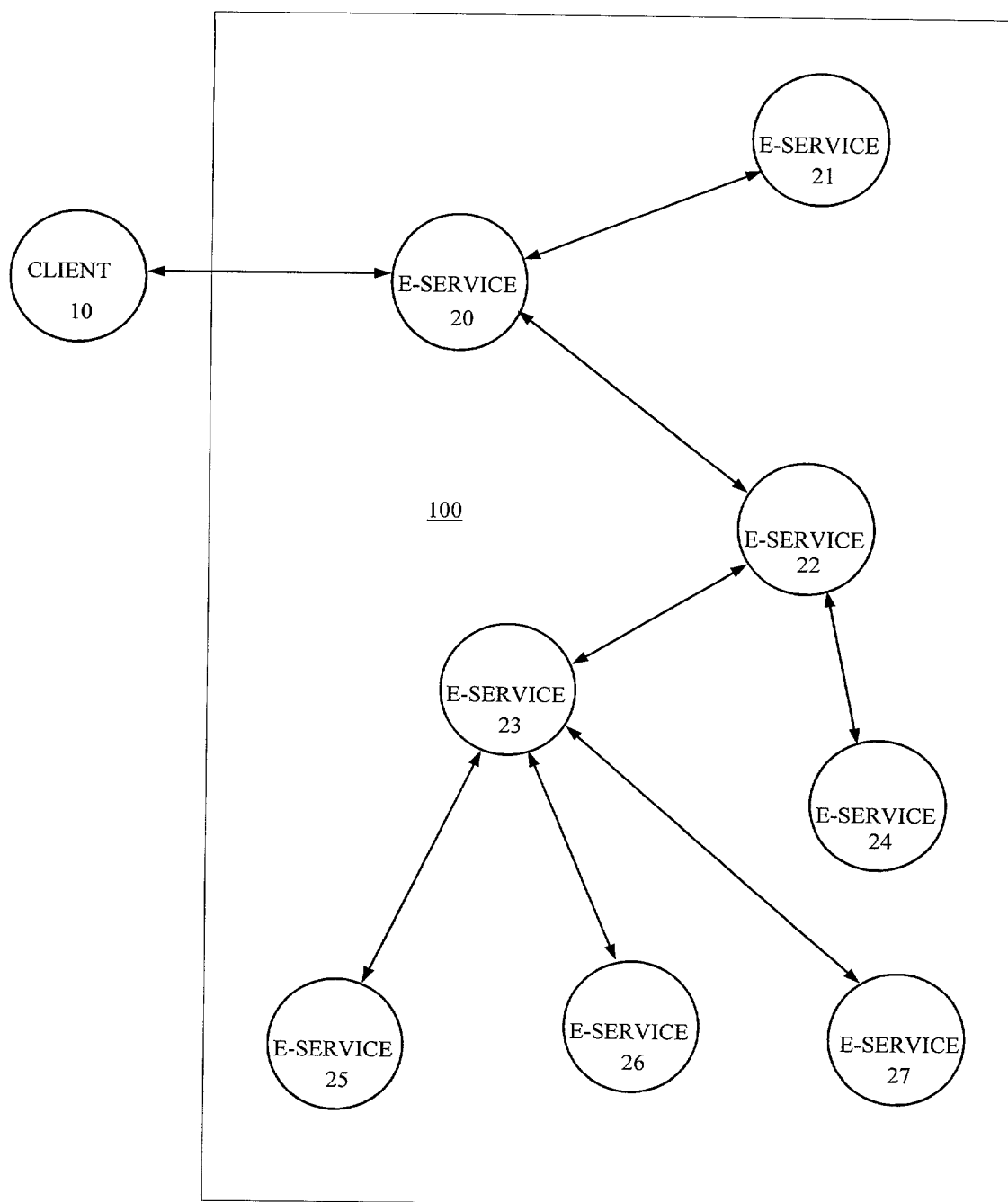


FIGURE 1

10991884

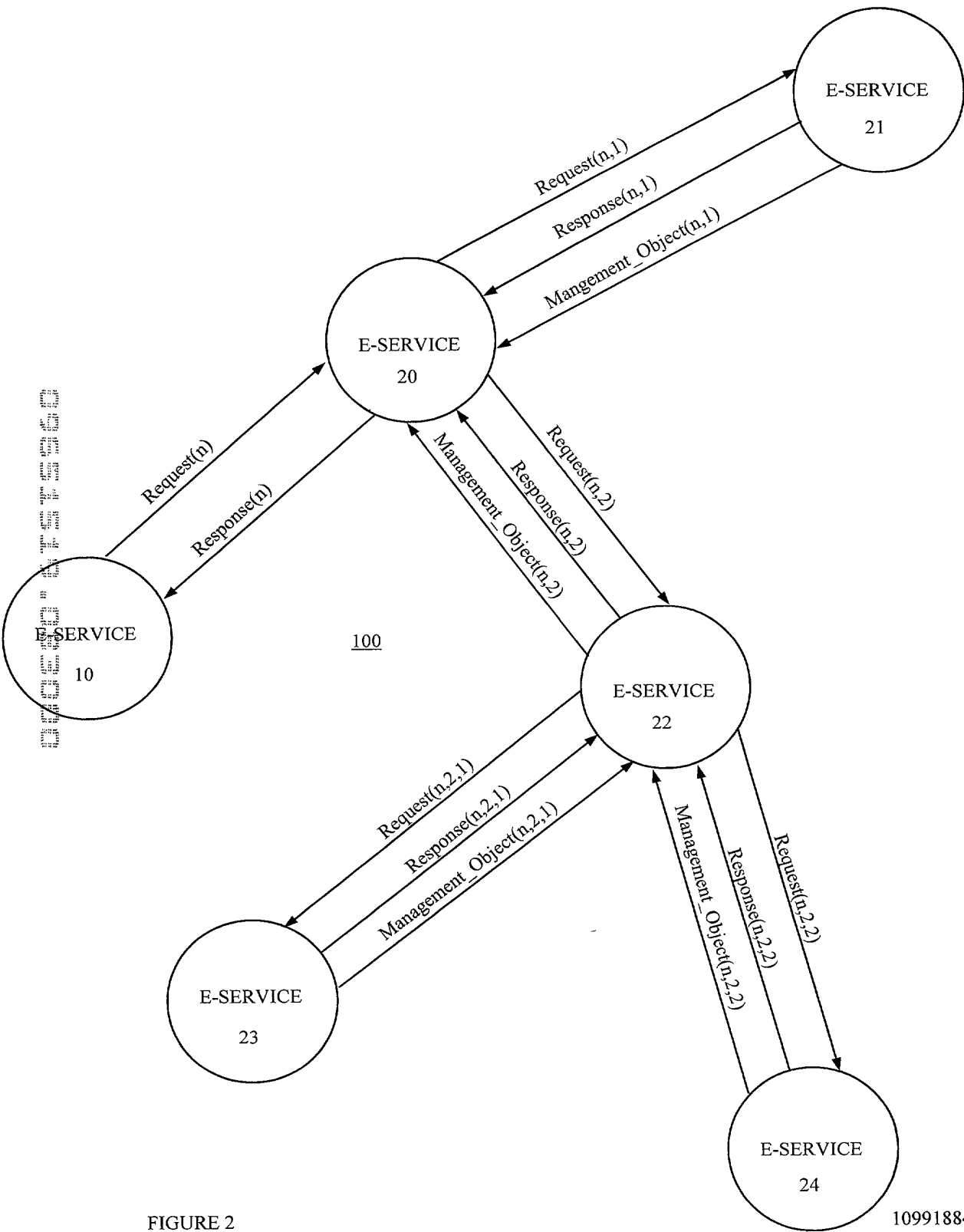


FIGURE 2

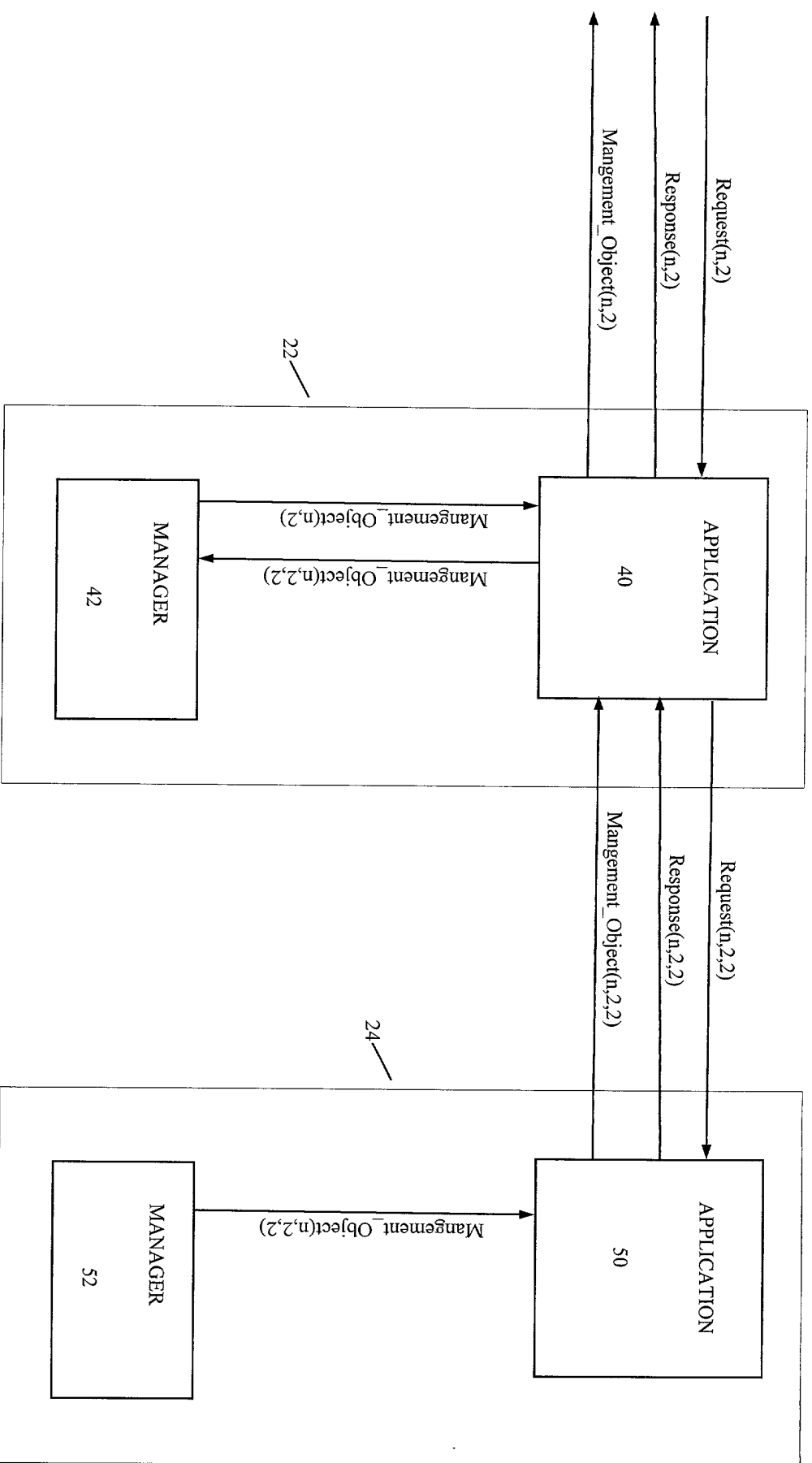


FIGURE 3

**DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION**ATTORNEY DOCKET NO. 10991884

As a below named inventor, I hereby declare that:

My residence/post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

DECENTRALIZED MANAGEMENT OF COMPOSITE DIGITAL SERVICES

the specification of which is attached hereto unless the following box is checked:

() was filed on _____ as US Application Serial No. or PCT International Application
Number _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understood the contents of the above-identified specification, including the claims, as amended by any amendment(s) referred to above. I acknowledge the duty to disclose all information which is material to patentability as defined in 37 CFR 1.56.

Foreign Application(s) and/or Claim of Foreign Priority

I hereby claim foreign priority benefits under Title 35, United States Code Section 119 of any foreign application(s) for patent or inventor(s) certificate listed below and have also identified below any foreign application for patent or inventor(s) certificate having a filing date before that of the application on which priority is claimed:

COUNTRY	APPLICATION NUMBER	DATE FILED	PRIORITY CLAIMED UNDER 35 U.S.C. 119
			YES _____ NO. _____
			YES _____ NO. _____

Provisional Application

I hereby claim the benefit under Title 35, United States Code Section 119(e) of any United States provisional application(s) listed below:

APPLICATION SERIAL NUMBER	FILING DATE

U. S. Priority Claim

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

APPLICATION SERIAL NUMBER	FILING DATE	STATUS (patented/pending/abandoned)

POWER OF ATTORNEY:

As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

Customer Number **022879**Place Customer
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HEWLETT-PACKARD COMPANY
Intellectual Property Administration
P.O. Box 272400
Fort Collins, Colorado 80527-2400**Direct Telephone Calls To:****Paul H. Horstmann**
(415) 602-1721

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Inventor: Akhil Sahai Citizenship: IndiaResidence: 20800 Homestead Road, Apt 39A Cupertino California 95014Post Office Address: 20800 Homestead Road, Apt 39A Cupertino California 95014Inventor's Signature Akhil Sahai Date 08/19/2010

**DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION (continued)**

ATTORNEY DOCKET NO. 10991884

Full Name of # 2 joint inventor: Sekhar Sarukkai Citizenship: India

Residence: 947-A La Mesa Terrace Sunnyvale California 94086

Post Office Address: 947-A La Mesa Terrace Sunnyvale California 94086

Inventor's Signature *Sekhar Sarukkai*

Date August 20 / 2020

Full Name of # 3 joint inventor: _____ Citizenship: _____

Residence: _____

Post Office Address: _____

Inventor's Signature _____

Date _____

Full Name of # 4 joint inventor: _____ Citizenship: _____

Residence: _____

Post Office Address: _____

Inventor's Signature _____

Date _____

Full Name of # 5 joint inventor: _____ Citizenship: _____

Residence: _____

Post Office Address: _____

Inventor's Signature _____

Date _____

Full Name of # 6 joint inventor: _____ Citizenship: _____

Residence: _____

Post Office Address: _____

Inventor's Signature _____

Date _____

Full Name of # 7 joint inventor: _____ Citizenship: _____

Residence: _____

Post Office Address: _____

Inventor's Signature _____

Date _____

Full Name of # 8 joint inventor: _____ Citizenship: _____

Residence: _____

Post Office Address: _____

Inventor's Signature _____

Date _____